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# Hells Canyon Reservoir, Baker and Wallowa Counties, Oregon Adams and Idaho Counties, Idaho

U.S. National Eutrophication Survey, Corvallis, Oreg

Prepared for

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# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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# REPORT

ON

# HELLS CANYON RESERVOIR
## BAKER AND WALLOWA COUNTIES, OREGON
## ADAMS AND IDAHO COUNTIES, IDAHO

EPA REGION X

WORKING PAPER No. 829

WITH THE COOPERATION OF THE

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY,

THE IDAHO DEPARTMENT OF HEALTH AND WELFARE,

AND THE OREGON NATIONAL GUARD

APRIL, 1978

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# FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Oregon Department of Environmental Quality and the Idaho Department of Health and Welfare for professional involvement and to the Oregon National Guard for conducting the tributary sampling phase of the Survey.

William H. Young, Director; Harold L. Sawyer, Administrator, and the staff of the Water Quality Control Division of the Oregon Department of Environmental Quality; and the staff of the Division of Environment of the Idaho Department of Health and Welfare provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

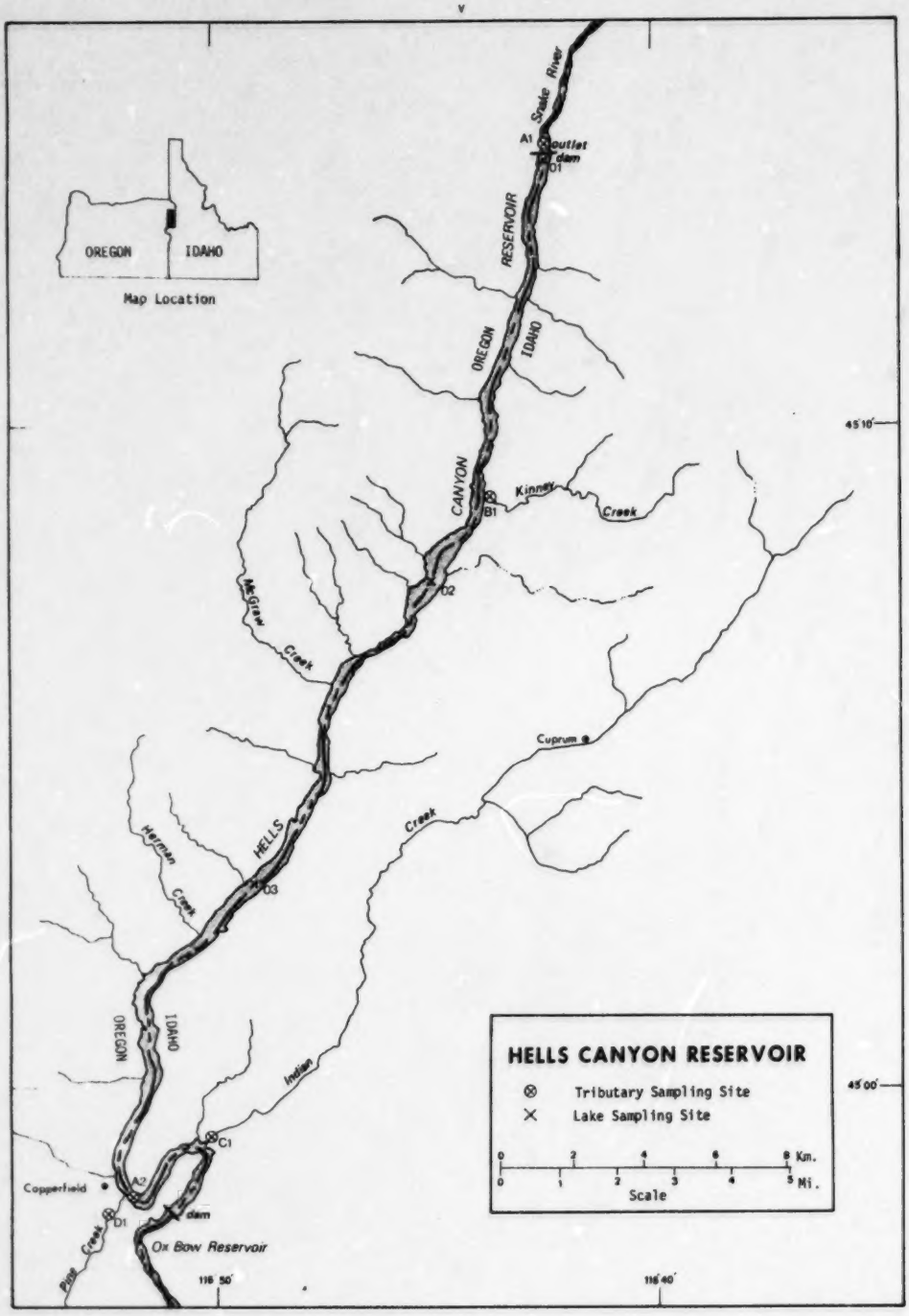
Brigadier General Richard A. Miller, the Adjutant General of Oregon, and Project Officer Lt. Colonel John Mewha, who directed the volunteer efforts of the Oregon National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

# NATIONAL EUTROPHICATION SURVEY

## STUDY LAKES and RESERVOIRS

## STATE OF OREGON

| NAME | COUNTY |
|---|---|
| Brownlee | Baker, OR; Washington, ID |
| Diamond | Douglas |
| Hells Canyon | Baker, Wallowa, OR; Adams, Idaho, ID |
| Hills Creek | Lane |
| Owyhee | Malhuer |
| Oxbow | Baker, OR; Adams, ID |
| Suttle | Jefferson |
| Waldo | Lane |


Snake River
A1
Outlet
dam
D1
RESERVOIR
OREGON
IDAHO
Map Location
OREGON
IDAHO
45°10'
CANYON
Kinney
Creek
B1
B2
McGraw
Creek
Cuprum
HELLS
Herman
Creek
B3
Creek
OREGON
IDAHO
Indian
C1
Copperfield
C2
D1
dam
Ox Bow Reservoir
Pine Creek
116°50'
116°40'
45°00'
HELLS CANYON RESERVOIR
Tributary Sampling Site
Lake Sampling Site
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale

# HELLS CANYON RESERVOIR

## STORET NO. 4103

## I. CONCLUSIONS

### A. Trophic Condition:

Survey data indicate Hells Canyon Reservoir is eutrophic. It ranked nineteenth in overall trophic quality when the 21 Oregon and Idaho lakes and reservoirs sampled in 1975 were compared using a combination of six water quality parameters*. Fifteen of the water bodies had less median total phosphorus, 19 had less median dissolved orthophosphorus and inorganic nitrogen, 18 had less mean chlorophyll a, and 16 had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at station 1 in August.

Survey limnologists noted a few emergent macrophytes along the shoreline in April. The rather high chlorophyll a concentrations in April and August indicate possible bloom conditions at those times.

### B. Rate-Limiting Nutrient:

The algal assay results are not considered representative of conditions in the reservoir at the times the samples were collected due to significant changes in nutrient concentrations in the samples during shipment from the field to the laboratory.

The reservoir data indicate phosphorus limitation in April and nitrogen limitation in August and September.

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* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No known point sources directly impacted Hells Canyon Reservoir during the sampling year. However, point sources which discharge to the Snake River upstream may be of significance since nearly 94% of the total phosphorus load leaving Brownlee Reservoir* reaches Hells Canyon Reservoir via Oxbow Reservoir*.

The present phosphorus loading of 93.11 $g/m^2$/year is 12 times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 12). Although Vollenweider's model may not be applicable to water bodies with short hydraulic retention times, the trophic condition of Hells Canyon Reservoir is evidence of excessive nutrient loads. Any improvement in water quality would involve the minimization of nutrient loads from both non-point sources and the point sources impacting upstream Brownlee Reservoir.

2. Non-point sources--As considered in this report, "non-point" sources include those contributing nutrients as a result of human activities (e.g., agricultural practices, urbanization, extractive processes, etc.) as well as natural sources (i.e., direct precipitation, leaf fall, wild birds and animals, etc.).

The apparent non-point source phosphorus contribution accounted for all of the load to Hells Canyon Reservoir during the sampling year. However, as noted above, much of the load is due to point sources upstream beyond the 40-kilometer Survey limit**.

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* Respectively, Working Paper No. 827 and 832.
** See Working Paper No. 175, "...Survey Methods, 1973-1976".

The Snake River contributed 95.0% of the total phosphorus load, Indian Creek contributed 0.4%, and Pine Creek contributed 3.2%. The ungaged minor tributaries and immediate drainage contributed an estimated 1.4%.

The phosphorus export rates of Indian and Pine creeks, 39 and 51 kg/km$^2$/year, were quite high as compared to the rate of the Snake River (5 kg/km$^2$/year) and may indicate the influence of land-use practices in the immediate drainage area. A further investigation would be needed to determine this. However, water quality improvement in Hells Canyon Reservoir would still require reduction of the nutrients impacting the Snake River which contributed 94% of the load.

## II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

### A. Morphometry††:

1. Surface area: 10.12 kilometers$^2$.
2. Mean depth: 20.4 meters.
3. Maximum depth: 64.9 meters.
4. Volume: 206.881 x $10^6$ $m^3$.
5. Mean hydraulic retention time: 4 days.

### B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

| Name | Drainage area ($km^2$)* | Mean flow ($m^3$/sec)* |
|---|---|---|
| Snake River | 188,810.9 | 532.660 |
| Indian Creek | 102.8 | 1.940 |
| Pine Creek | 595.7 | 10.860 |
| Minor tributaries & immediate drainage - | 327.4 | 8.490 |
| Totals | 189,836.8 | 553.950** |

2. Outlet -

| | | |
|---|---|---|
| Snake River | 189,846.9*** | 553.950 |

### C. Precipitation****:

1. Year of sampling: 27.0 centimeters.
2. Mean annual: 27.3 centimeters.

---

† Table of metric equivalents--Appendix B.
†† McHugh, 1972.
* For limits of accuracy, see Working Paper No. 175.
** Sum of inflows adjusted to equal outflow.
*** Includes area of reservoir.
**** See Working Paper No. 175.

## III. WATER QUALITY SUMMARY

Hells Canyon Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 48.8 meters at station 1, 29.0 meters at station 2, and 16.2 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR HELLS CANYON RESERVOIR
STORET CODE 4103

| PARAMETER | 1ST SAMPLING ( 4/ 8/75) 3 SITES RANGE | MEAN | MEDIAN | 2ND SAMPLING ( 8/ 4/75) 3 SITES RANGE | MEAN | MEDIAN | 3RD SAMPLING ( 9/15/75) 3 SITES RANGE | MEAN | MEDIAN |
|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | 6.6 - 7.0 | 6.7 | 6.7 | 18.1 - 23.4 | 21.5 | 21.4 | 21.0 - 22.3 | 21.4 | 21.2 |
| DISS OXY (MG/L) | 13.4 - 14.6 | 14.4 | 14.6 | 2.6 - 11.2 | 7.4 | 7.1 | 4.6 - 7.8 | 5.7 | 5.4 |
| CNDCTVY (MCROMO) | 235. - 243. | 238. | 237. | 240. - 269. | 258. | 260. | 396. - 421. | 412. | 412. |
| PH (STAND UNITS) | 8.4 - 8.5 | 8.5 | 8.5 | 8.0 - 9.4 | 8.7 | 8.6 | 8.1 - 8.3 | 8.2 | 8.2 |
| TOT ALK (MG/L) | 135. - 140. | 138. | 138. | 98. - 107. | 103. | 103. | 152. - 164. | 159. | 159. |
| TOT P (MG/L) | 0.079 - 0.093 | 0.087 | 0.087 | 0.029 - 0.061 | 0.040 | 0.041 | 0.065 - 0.080 | 0.072 | 0.073 |
| ORTHO P (MG/L) | 0.027 - 0.051 | 0.041 | 0.042 | 0.006 - 0.049 | 0.021 | 0.021 | 0.052 - 0.067 | 0.060 | 0.062 |
| NO2+NO3 (MG/L) | 0.680 - 0.780 | 0.752 | 0.770 | 0.020 - 0.320 | 0.194 | 0.245 | 0.570 - 0.690 | 0.650 | 0.680 |
| AMMONIA (MG/L) | 0.040 - 0.050 | 0.043 | 0.040 | 0.020 - 0.050 | 0.035 | 0.035 | 0.020 - 0.020 | 0.020 | 0.020 |
| KJEL N (MG/L) | 0.200 - 0.800 | 0.370 | 0.350 | 0.200 - 0.400 | 0.300 | 0.300 | 0.200 - 0.400 | 0.222 | 0.200 |
| INORG N (MG/L) | 0.720 - 0.830 | 0.795 | 0.810 | 0.050 - 0.360 | 0.229 | 0.270 | 0.590 - 0.710 | 0.670 | 0.700 |
| TOTAL N (MG/L) | 0.970 - 1.540 | 1.122 | 1.100 | 0.400 - 0.570 | 0.494 | 0.500 | 0.770 - 1.080 | 0.872 | 0.880 |
| CHLRPYL A (UG/L) | 17.2 - 27.9 | 22.6 | 22.8 | 9.6 - 33.4 | 24.4 | 30.3 | 7.5 - 10.0 | 9.1 | 9.8 |
| SECCHI (METERS) | 0.7 - 0.8 | 0.7 | 0.7 | 1.8 - 2.9 | 2.4 | 2.4 | 1.8 - 2.9 | 2.3 | 2.1 |

B. Biological characteristics:

1. Phytoplankton -

| Sampling Date | Dominant Genera | Algal Units per ml |
|---|---|---|
| 04/08/75 | 1. *Stephanodiscus sp.* | 7,332 |
| | 2. *Asterionella sp.* | 296 |
| | 3. *Melosira sp.* | 148 |
| | 4. *Fragilaria sp.* | 111 |
| | 5. *Surirella sp.* | 111 |
| | Other genera | 334 |
| | Total | 8,332 |
| 08/04/75 | 1. *Fragilaria sp.* | 6,928 |
| | 2. *Melosira sp.* | 3,322 |
| | 3. *Asterionella sp.* | 608 |
| | 4. *Skeletonema sp.* | 405 |
| | 5. *Cryptomonas sp.* | 162 |
| | Other genera | 163 |
| | Total | 11,588 |
| 09/15/75 | 1. *Chroomonas* (?) *sp.* | 795 |
| | 2. *Melosira sp.* | 614 |
| | 3. *Stephanodiscus sp.* | 36 |
| | 4. *Cryptomonas sp.* | 36 |
| | 5. *Schroederia sp.* | 36 |
| | Total | 1,517 |

2. Chlorophyll *a* -

| Sampling Date | Station Number | Chlorophyll *a* (µg/l) |
|---|---|---|
| 04/08/75 | 1 | 27.9 |
| | 2 | 17.2 |
| | 3 | 22.8 |
| 08/04/75 | 1 | 33.4 |
| | 2 | 30.3 |
| | 3 | 9.6 |
| 09/15/75 | 1 | 7.5 |
| | 2 | 9.8 |
| | 3 | 10.0 |

C. Limiting Nutrient Study:

The algal assay results are not considered representative of conditions in the reservoir at the times samples were collected (04/08/75 and 09/15/75) due to significant nutrient changes in the samples during shipment from the field to the laboratory.

The reservoir data indicate phosphorus limitation in April and nitrogen limitation in August and September. The mean inorganic nitrogen/orthophosphorus ratios were 18/1 or greater at all stations in April and 13/1 or less at all stations in August and September.

## IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Oregon National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of January and February when two samples were collected. Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Oregon District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampling tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station C-1, in $kg/km^2/year$, and multiplying by the ZZ area in $km^2$.

No known wastewater treatment plants directly impacted Hells Canyon Reservoir during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

| Source | kg P/ yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| Snake River | 895,060 | 95.0 |
| Indian Creek | 3,985 | 0.4 |
| Pine Creek | 30,295 | 3.2 |
| b. Minor tributaries & immediate drainage (non-point load) - | 12,770 | 1.4 |
| c. Known municipal STP's - None | - | - |
| d. Septic tanks - None | - | - |
| e. Known industrial - None | - | - |
| f. Direct precipitation* - | 175 | < 0.1 |
| Total | 942,285 | 100.0 |

2. Outputs -

Reservoir outlet - Snake River 1,017,465

3. Net annual P loss - 75,180 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

| Source | kg N/yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| Snake River | 25,222,530 | 97.4 |
| Indian Creek | 68,915 | 0.3 |
| Pine Creek | 367,060 | 1.4 |
| b. Minor tributaries & immediate drainage (non-point load) - | 219,360 | 0.8 |
| c. Known municipal STP's - None | - | - |
| d. Septic tanks - None | - | - |
| e. Known industrial - None | - | - |
| f. Direct precipitation* - | 10,925 | < 0.1 |
| Total | 25,888,790 | 100.0 |

2. Outputs -

Reservoir outlet - Snake River 21,630,255

3. Net annual N accumulation - 4,258,535 kg.

D. Non-point Nutrient Export by Subdrainage Area:

| Tributary | kg P/km²/yr | kg N/km²/yr |
|---|---|---|
| Snake River | 5 | 134 |
| Indian Creek | 39 | 670 |
| Pine Creek | 51 | 616 |

E. Mean Nutrient Concentrations in Ungaged Stream:

| Tributary | Mean Total P Conc. (mg/l) | Mean Total N Conc. (mg/l) |
|---|---|---|
| Kinney Creek | 0.042 | 0.654 |

* See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

| | Total Phosphorus | | Total Nitrogen | |
|---|---|---|---|---|
| | Total | Accumulated | Total | Accumulated |
| grams/$m^2$/yr | 93.11 | loss* | 2,558.2 | 420.8 |

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Hells Canyon Reservoir:

| | |
|---|---|
| "Dangerous" (eutrophic loading) | 7.60 |
| "Permissible" (oligotrophic loading) | 3.80 |

* There was an apparent loss of phosphorus during the sampling year. This may have been due to solubilization of previously sedimented phosphorus, recharge with phosphorus-rich ground water, unsampled point sources discharging directly to the reservoir, or (probably) insufficient outlet sampling in relation to the very short hydraulic retention time of the reservoir.

## V. LITERATURE REVIEWED

McHugh, Robert A., 1972. Interim study of some physical, chemical, and biological properties of selected Oregon lakes. OR Dept. of Environ. Qual., Portland.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

# VI. APPENDICES

## APPENDIX A

## LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500-MEAN SEC | MEAN CHLORA | 15-MIN DO | MEDIAN DISS ORTHO P |
|---|---|---|---|---|---|---|---|
| 1601 | AMERICAN FALLS RESERVOIR | 0.105 | 0.080 | 463.800 | 15.379 | 14.700 | 0.035 |
| 1602 | CASCADE LAKE | 0.032 | 0.060 | 415.067 | 8.081 | 14.600 | 0.009 |
| 1603 | LAKE COEUR D'ALENE | 0.017 | 0.040 | 380.348 | 10.391 | 12.200 | 0.005 |
| 1604 | DWORSHAK RESERVOIR | 0.010 | 0.080 | 401.866 | 2.420 | 7.400 | 0.009 |
| 1605 | HAUSER | 0.028 | 0.075 | 366.286 | 11.112 | 14.800 | 0.013 |
| 1606 | HAYDEN LAKE | 0.010 | 0.040 | 243.500 | 2.787 | 11.800 | 0.003 |
| 1607 | ISLAND PARK RESERVOIR | 0.034 | 0.050 | 391.778 | 9.322 | 12.800 | 0.012 |
| 1608 | LAKE LOWELL | 0.070 | 0.070 | 477.111 | 25.389 | 14.600 | 0.015 |
| 1609 | MAGIC RESERVOIR | 0.062 | 0.130 | 400.750 | 7.322 | 14.700 | 0.020 |
| 1610 | PALISADES RESERVOIR | 0.024 | 0.080 | 345.428 | 2.067 | 12.800 | 0.007 |
| 1611 | LOWER PAYETTE | 0.013 | 0.060 | 234.000 | 4.600 | 9.600 | 0.007 |
| 1612 | LOWER TWIN LAKES | 0.016 | 0.050 | 370.000 | 2.318 | 13.600 | 0.009 |
| 1613 | UPPER TWIN LAKES | 0.017 | 0.045 | 369.143 | 34.962 | 8.200 | 0.004 |
| 4101 | BROWNLEE RESERVOIR | 0.079 | 0.560 | 428.133 | 16.207 | 14.500 | 0.043 |
| 4102 | DIAMOND LAKE | 0.028 | 0.040 | 294.500 | 7.300 | 6.800 | 0.011 |
| 4103 | HELLS CANYON RESERVOIR | 0.068 | 0.640 | 429.111 | 18.722 | 12.400 | 0.045 |
| 4104 | HILLS CREEK RESERVOIR | 0.038 | 0.060 | 435.200 | 2.333 | 7.400 | 0.027 |
| 4105 | OWYHEE | 0.095 | 0.425 | 480.417 | 3.350 | 13.200 | 0.064 |
| 4106 | OXBOW RESERVOIR | 0.071 | 0.690 | 425.555 | 10.311 | 12.200 | 0.040 |
| 4107 | [illegible]UTTLE LAKE | 0.031 | 0.040 | 95.000 | 9.167 | 6.800 | 0.020 |
| 4108 | WALDO LAKE | 0.005 | 0.040 | -100.000 | 0.350 | 6.800 | 0.006 |

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | MEDIAN TOTAL P | MEDIAN INORG N | 500- MEAN SEC | MEAN CHLORA | 15- MIN DO | MEDIAN DISS ORTHO P | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 1601 | AMERICAN FALLS RESERVOIR | 0 ( 0) | 30 ( 5) | 10 ( 2) | 20 ( 4) | 13 ( 2) | 20 ( 4) | 93 |
| 1602 | CASCADE LAKE | 45 ( 9) | 58 ( 11) | 35 ( 7) | 50 ( 10) | 3 ( 0) | 65 ( 12) | 256 |
| 1603 | LAKE COEUR D'ALENE | 75 ( 15) | 93 ( 17) | 55 ( 11) | 30 ( 6) | 58 ( 11) | 90 ( 18) | 401 |
| 1604 | DWORSHAK RESERVOIR | 93 ( 18) | 30 ( 5) | 40 ( 8) | 80 ( 16) | 83 ( 16) | 65 ( 12) | 391 |
| 1605 | HAUSER | 58 ( 11) | 40 ( 8) | 70 ( 14) | 25 ( 5) | 3 ( 0) | 45 ( 9) | 241 |
| 1606 | HAYDEN LAKE | 93 ( 18) | 93 ( 17) | 85 ( 17) | 75 ( 15) | 65 ( 13) | 100 ( 20) | 511 |
| 1607 | ISLAND PARK RESERVOIR | 40 ( 8) | 68 ( 13) | 50 ( 10) | 40 ( 8) | 43 ( 8) | 50 ( 10) | 291 |
| 1608 | LAKE LOWELL | 20 ( 4) | 45 ( 9) | 5 ( 1) | 5 ( 1) | 20 ( 4) | 40 ( 8) | 135 |
| 1609 | MAGIC RESERVOIR | 30 ( 6) | 20 ( 4) | 45 ( 9) | 55 ( 11) | 13 ( 2) | 30 ( 6) | 193 |
| 1610 | PALISADES RESERVOIR | 65 ( 13) | 30 ( 5) | 75 ( 15) | 95 ( 19) | 43 ( 8) | 80 ( 16) | 388 |
| 1611 | LOWER PAYETTE | 85 ( 17) | 58 ( 11) | 90 ( 18) | 65 ( 13) | 70 ( 14) | 75 ( 15) | 443 |
| 1612 | LOWER TWIN LAKES | 80 ( 16) | 68 ( 13) | 60 ( 12) | 90 ( 18) | 30 ( 6) | 65 ( 12) | 393 |
| 1613 | UPPER TWIN LAKES | 70 ( 14) | 75 ( 15) | 65 ( 13) | 0 ( 0) | 75 ( 15) | 95 ( 19) | 380 |
| 4101 | BROWNLEE RESERVOIR | 10 ( 2) | 10 ( 2) | 25 ( 5) | 15 ( 3) | 25 ( 5) | 10 ( 2) | 95 |
| 4102 | DIAMOND LAKE | 58 ( 11) | 93 ( 17) | 80 ( 16) | 60 ( 12) | 95 ( 18) | 55 ( 11) | 441 |
| 4103 | HELLS CANYON RESERVOIR | 25 ( 5) | 5 ( 1) | 20 ( 4) | 10 ( 2) | 50 ( 10) | 5 ( 1) | 115 |
| 4104 | HILLS CREEK RESERVOIR | 35 ( 7) | 50 ( 10) | 15 ( 3) | 85 ( 17) | 83 ( 16) | 25 ( 5) | 293 |
| 4105 | OWYHEE | 5 ( 1) | 15 ( 3) | 0 ( 0) | 70 ( 14) | 35 ( 7) | 0 ( 0) | 125 |
| 4106 | OXBOW RESERVOIR | 15 ( 3) | 0 ( 0) | 30 ( 6) | 35 ( 7) | 58 ( 11) | 15 ( 3) | 153 |
| 4107 | SUTTLE LAKE | 50 ( 10) | 80 ( 16) | 95 ( 19) | 45 ( 9) | 95 ( 18) | 35 ( 7) | 400 |
| 4108 | WALDO LAKE | 100 ( 20) | 93 ( 17) | 100 ( 20) | 100 ( 20) | 95 ( 18) | 85 ( 17) | 573 |

LAKES RANKED BY INDEX NOS.

| RANK | LAKE CODE | LAKE NAME | INDEX NO |
|---|---|---|---|
| 1 | 4108 | WALDO LAKE | 573 |
| 2 | 1606 | HAYDEN LAKE | 511 |
| 3 | 1611 | LOWER PAYETTE | 443 |
| 4 | 4102 | DIAMOND LAKE | 441 |
| 5 | 1603 | LAKE COEUR D'ALENE | 401 |
| 6 | 4107 | SUTTLE LAKE | 400 |
| 7 | 1612 | LOWER TWIN LAKES | 393 |
| 8 | 1604 | DWORSHAK RESERVOIR | 391 |
| 9 | 1610 | PALISADES RESERVOIR | 388 |
| 10 | 1613 | UPPER TWIN LAKES | 380 |
| 11 | 4104 | HILLS CREEK RESERVOIR | 293 |
| 12 | 1607 | ISLAND PARK RESERVOIR | 291 |
| 13 | 1602 | CASCADE LAKE | 256 |
| 14 | 1605 | HAUSER | 241 |
| 15 | 1609 | MAGIC RESERVOIR | 193 |
| 16 | 4106 | OXBOW RESERVOIR | 153 |
| 17 | 1608 | LAKE LOWELL | 135 |
| 18 | 4105 | OWYHEE | 125 |
| 19 | 4103 | HELLS CANYON RESERVOIR | 115 |
| 20 | 4101 | BROWNLEE RESERVOIR | 95 |
| 21 | 1601 | AMERICAN FALLS RESERVOIR | 93 |

# APPENDIX B

## CONVERSION FACTORS

## CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x $8.107 \times 10^{-4}$ = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

# APPENDIX C

## TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR OREGON 08/11/76

LAKE CODE 4103 HELLS CANYON RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 189846.9

| TRIBUTARY | SUB-DRAINAGE AREA(SQ KM) | NORMALIZED FLOWS(CMS) JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4103A1 | 189846.9 | 625.80 | 756.36 | 716.42 | 758.89 | 673.94 | 656.95 | 342.63 | 319.98 | 396.44 | 447.41 | 453.07 | 521.03 | 553.95 |
| 4103A2 | 189810.9 | 597.49 | 713.58 | 676.77 | 716.42 | 634.30 | 620.14 | 336.97 | 325.64 | 396.44 | 447.41 | 444.57 | 501.21 | 532.66 |
| 4103C1 | 102.8 | 0.85 | 0.85 | 2.27 | 2.55 | 5.66 | 5.66 | 1.98 | 0.71 | 0.57 | 0.71 | 0.71 | 0.71 | 1.94 |
| 4103D1 | 595.7 | 11.50 | 11.67 | 15.77 | 15.86 | 29.53 | 26.87 | 5.01 | 1.19 | 1.36 | 1.97 | 3.60 | 6.14 | 10.86 |
| 4103Z7 | 295.3 | 1.19 | 1.42 | 1.93 | 2.21 | 6.80 | 3.96 | 1.93 | 0.57 | 0.45 | 0.57 | 0.57 | 0.62 | 1.85 |

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 189846.9
SUM OF SUB-DRAINAGE AREAS = 189804.7

TOTAL FLOW IN = 6586.74
TOTAL FLOW OUT = 6668.60

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|---|---|---|---|---|---|---|---|---|---|
| 4103A1 | 10 | 74 | 501.208 | 20 | 419.089 | | | | |
| | 11 | 74 | 498.376 | 23 | 501.208 | | | | |
| | 12 | 74 | 532.357 | 14 | 376.614 | | | | |
| | 1 | 75 | 639.961 | 4 | 639.961 | 25 | 665.446 | | |
| | 2 | 75 | 773.050 | 9 | 552.178 | 22 | 991.090 | | |
| | 3 | 75 | 993.921 | 9 | 1030.733 | | | | |
| | 4 | 75 | 1404.516 | 13 | 1274.258 | | | | |
| | 5 | 75 | 1489.466 | 17 | 1543.268 | | | | |
| | 6 | 75 | 849.505 | 7 | 855.169 | | | | |
| | 7 | 75 | 436.079 | | | | | | |
| | 8 | 75 | 348.297 | 9 | 319.980 | | | | |
| | 9 | 75 | 464.396 | 28 | 402.099 | | | | |
| 4103A2 | 10 | 74 | 501.208 | 19 | 410.594 | | | | |
| | 11 | 74 | 495.545 | 23 | 521.030 | | | | |
| | 12 | 74 | 523.862 | 14 | 538.020 | | | | |
| | 1 | 75 | 614.476 | 4 | 620.139 | 25 | 614.476 | | |
| | 2 | 75 | 719.248 | 9 | 569.168 | 22 | 894.812 | | |
| | 3 | 75 | 877.822 | 9 | 897.644 | | | | |
| | 4 | 75 | 1268.595 | 13 | 1155.327 | | | | |
| | 5 | 75 | 1347.882 | 17 | 82.119 | | | | |
| | 6 | 75 | 733.406 | 7 | 744.733 | | | | |
| | 7 | 75 | 413.426 | | | | | | |
| | 8 | 75 | 328.475 | 9 | 311.485 | | | | |
| | 9 | 75 | 444.574 | 28 | 430.416 | | | | |

12

TRIBUTARY FLOW INFORMATION FOR OREGON 08/11/76

LAKE CODE 4103 HELLS CANYON RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|---|---|---|---|---|---|---|---|---|---|
| 4103C1 | 10 | 74 | 0.425 | 20 | 0.396 | | | | |
| | 11 | 74 | 0.311 | 23 | 0.340 | | | | |
| | 12 | 74 | 0.255 | 14 | 0.283 | | | | |
| | 1 | 75 | 0.227 | 4 | 0.283 | 25 | 0.283 | | |
| | 2 | 75 | 0.510 | 9 | 0.396 | 22 | 0.453 | | |
| | 3 | 75 | 1.416 | 9 | 2.124 | | | | |
| | 4 | 75 | 1.699 | 13 | 1.557 | | | | |
| | 5 | 75 | 3.681 | 17 | 4.814 | | | | |
| | 6 | 75 | 4.531 | 7 | 5.663 | | | | |
| | 7 | 75 | 2.407 | | | | | | |
| | 8 | 75 | 0.708 | 9 | 0.510 | | | | |
| | 9 | 75 | 0.368 | 28 | 0.283 | | | | |
| 4103D1 | 10 | 74 | 1.812 | 20 | 1.727 | | | | |
| | 11 | 74 | 2.520 | 23 | 2.747 | | | | |
| | 12 | 74 | 2.633 | 14 | 2.690 | | | | |
| | 1 | 75 | 3.030 | 3 | 2.549 | 25 | 3.794 | | |
| | 2 | 75 | 6.400 | 9 | 4.474 | 22 | 5.182 | | |
| | 3 | 75 | 16.820 | 9 | 27.269 | | | | |
| | 4 | 75 | 16.395 | 13 | 15.404 | | | | |
| | 5 | 75 | 28.317 | 17 | 42.192 | | | | |
| | 6 | 75 | 32.564 | 7 | 43.891 | | | | |
| | 7 | 75 | 11.072 | | | | | | |
| | 8 | 75 | 2.265 | 9 | 1.557 | | | | |
| | 9 | 75 | 1.642 | 28 | 1.218 | | | | |

# APPENDIX D

## PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/12

410301
45 14 15.0 116 42 08.0 3
HELLS CANYON RESERVOIR
41063 OREGON

130892

11EPALES 2111202
0155 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/04/08 | 14 45 | 0000 | 6.6 | | 26 | 241 | 8.45 | 139 | 0.040 | 0.300 | 0.770 | 0.043 |
| | 14 45 | 0005 | 6.8 | 14.6 | | 235 | 8.45 | 140 | 0.040 | 0.200 | 0.770 | 0.036 |
| | 14 45 | 0015 | 6.7 | 14.4 | | 236 | 8.45 | 137 | 0.050 | 0.200 | 0.770 | 0.035 |
| | 14 45 | 0050 | 6.6 | 14.6 | | 239 | 8.50 | 138 | 0.040 | 0.400 | 0.770 | 0.051 |
| | 14 45 | 0100 | 6.6 | 14.4 | | 237 | 8.50 | 136 | 0.050 | 0.300 | 0.770 | 0.048 |
| | 14 45 | 0150 | 6.6 | 14.6 | | 239 | 8.50 | 135 | 0.050 | 0.400 | 0.780 | 0.041 |
| 75/08/04 | 07 30 | 0000 | 22.9 | 10.2 | 96 | 245 | 9.00 | 104 | 0.030 | 0.400 | 0.070 | 0.015 |
| | 07 30 | 0005 | 22.5 | 6.4 | | 260 | 9.05 | 103 | 0.030 | 0.300 | 0.100 | 0.006 |
| | 07 30 | 0015 | 22.5 | 9.0 | | 269 | 8.60 | 101 | 0.040 | 0.300 | 0.210 | 0.014 |
| | 07 30 | 0040 | 21.6 | 6.6 | | 257 | 8.60 | 102 | 0.050 | 0.300 | 0.210 | 0.024 |
| | 07 30 | 0070 | 20.1 | 6.2 | | 255 | 8.40 | 102 | 0.040 | 0.300 | 0.240 | 0.030 |
| | 07 30 | 0110 | 20.8 | 5.8 | | 253 | 8.30 | 102 | 0.040 | 0.200 | 0.270 | 0.027 |
| | 07 30 | 0135 | 20.8 | 4.4 | | 248 | 8.20 | 102 | 0.040 | 0.200 | 0.290 | 0.038 |
| | 07 30 | 0160 | 18.1 | 2.6 | | 240 | 8.00 | 102 | 0.040 | 0.200 | 0.320 | 0.049 |
| 75/09/15 | 13 30 | 0000 | 22.2 | 7.2 | 115 | 407 | 8.20 | 152 | 0.020K | 0.200 | 0.570 | 0.052 |
| | 13 30 | 0005 | 22.3 | 7.2 | | 410 | 8.30 | 153 | 0.020K | 0.200 | 0.580 | 0.055 |
| | 13 30 | 0018 | 22.0 | 7.8 | | 410 | 8.30 | 155 | 0.020K | 0.300 | 0.590 | 0.053 |
| | 13 30 | 0040 | 21.8 | 7.4 | | 410 | 8.30 | 153 | 0.020K | 0.200 | 0.580 | 0.054 |
| | 13 30 | 0075 | 21.2 | 5.6 | | 405 | 8.15 | 153 | 0.020K | 0.200 | 0.620 | 0.057 |
| | 13 30 | 0110 | 21.1 | 5.0 | | 408 | 8.10 | 156 | 0.020K | 0.200 | 0.640 | 0.057 |
| | 13 30 | 0145 | 21.0 | 4.6 | | 396 | 8.10 | 153 | 0.020K | 0.200K | 0.620 | 0.056 |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

410301
45 14 15.0 116 42 08.0 3
HELLS CANYON RESERVOIR
41063 OREGON
130892

11EPALES 2111202
0155 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/04/08 | 14 45 | 0000 | 0.086 | 27.9 | |
| | 14 45 | 0005 | 0.092 | | |
| | 14 45 | 0015 | 0.088 | | |
| | 14 45 | 0050 | 0.088 | | |
| | 14 45 | 0100 | 0.090 | | |
| | 14 45 | 0150 | 0.093 | | |
| 75/08/04 | 07 30 | 0000 | 0.030 | 33.4 | |
| | 07 30 | 0005 | 0.029 | | |
| | 07 30 | 0015 | 0.036 | | |
| | 07 30 | 0040 | 0.038 | | |
| | 07 30 | 0070 | 0.043 | | |
| | 07 30 | 0110 | 0.046 | | |
| | 07 30 | 0135 | 0.050 | | |
| | 07 30 | 0160 | 0.061 | | |
| 75/09/15 | 13 30 | 0000 | 0.078 | 7.5 | |
| | 13 30 | 0005 | 0.068 | | |
| | 13 30 | 0018 | 0.065 | | |
| | 13 30 | 0040 | 0.065 | | |
| | 13 30 | 0075 | 0.068 | | |
| | 13 30 | 0110 | 0.070 | | |
| | 13 30 | 0145 | 0.076 | | |

STORET RETRIEVAL DATE 76/08/12

410302
45 07 35.0 116 44 42.0 3
HELLS CANYON RESERVOIR
41063 OREGON

130892

11EPALES 2111202
0030 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/04/08 | 11 45 | 0000 | 6.8 | 14.6 | 29 | 235 | 8.50 | 138 | 0.040 | 0.400 | 0.730 | 0.050 |
| | 11 45 | 0015 | 6.8 | 14.6 | | 235 | 8.50 | 139 | 0.040 | 0.400 | 0.740 | 0.033 |
| | 11 45 | 0026 | 7.0 | 13.4 | | 235 | 8.50 | 138 | 0.040 | 0.800 | 0.740 | 0.049 |
| 75/08/04 | 08 10 | 0000 | 23.4 | 10.4 | 72 | 269 | 9.00 | 103 | 0.020 | 0.400 | 0.040 | 0.008 |
| | 08 10 | 0005 | 23.4 | 11.2 | | 261 | 9.40 | 103 | 0.030 | 0.400 | 0.020K | 0.014 |
| | 08 10 | 0015 | 22.9 | 10.0 | | 259 | 9.15 | 104 | 0.050 | 0.400 | 0.030 | 0.006 |
| | 08 10 | 0035 | 21.0 | 7.2 | | 253 | 8.75 | 102 | 0.050 | 0.300 | 0.160 | 0.020 |
| | 08 10 | 0069 | 20.6 | 6.8 | | 249 | 8.50 | 105 | 0.040 | 0.300 | 0.270 | 0.023 |
| 75/09/15 | 14 00 | 0000 | 21.8 | 5.8 | 72 | 421 | 8.20 | 158 | 0.020K | 0.200 | 0.680 | 0.060 |
| | 14 00 | 0005 | 21.7 | 5.8 | | 416 | 8.20 | 159 | 0.020K | 0.200 | 0.680 | 0.063 |
| | 14 00 | 0015 | 21.3 | 5.6 | | 415 | 8.20 | 163 | 0.020K | 0.300 | 0.680 | 0.067 |
| | 14 00 | 0040 | 21.2 | 5.0 | | 412 | 8.10 | 159 | 0.020K | 0.200 | 0.680 | 0.066 |
| | 14 00 | 0070 | 21.1 | 5.2 | | 412 | 8.10 | 162 | 0.020K | 0.400 | 0.680 | 0.063 |
| | 14 00 | 0095 | 21.1 | 4.8 | | 410 | 8.10 | 161 | 0.020K | 0.200K | 0.680 | 0.062 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/04/08 | 11 45 | 0000 | 0.087 | 17.2 | |
| | 11 45 | 0015 | 0.079 | | |
| | 11 45 | 0026 | 0.084 | | |
| 75/08/04 | 08 10 | 0000 | 0.033 | 30.3 | |
| | 08 10 | 0005 | 0.031 | | |
| | 08 10 | 0015 | 0.034 | | |
| | 08 10 | 0035 | 0.036 | | |
| | 08 10 | 0069 | 0.044 | | |
| 75/09/15 | 14 00 | 0000 | 0.069 | 9.8 | |
| | 14 00 | 0005 | 0.073 | | |
| | 14 00 | 0015 | 0.073 | | |
| | 14 00 | 0040 | 0.067 | | |
| | 14 00 | 0070 | 0.075 | | |
| | 14 00 | 0095 | 0.076 | | |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

410303
45 02 58.0 116 48 35.0 3
HELLS CANYON RESERVOIR
41001 OREGON
130891

11EPALES 2111202
0999 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00610 NH3-N TOTAL MG/L | 00625 TOT KJEL N MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75/04/08 | 10 25 | 0000 | 6.7 | 14.4 | 30 | 243 | 8.55 | 138 | 0.040 | 0.300 | 0.680 | 0.027 |
| | 10 25 | 0015 | 6.9 | | | 241 | | | | | | |
| 75/08/04 | 08 35 | 0000 | 21.4 | 7.0 | 114 | 261 | 8.65 | 106 | 0.020 | 0.200 | 0.250 | 0.020 |
| | 08 35 | 0005 | 21.4 | 7.2 | | 267 | 8.60 | 107 | 0.030 | 0.300 | 0.260 | 0.022 |
| | 08 35 | 0015 | 21.4 | 7.4 | | 263 | 8.60 | 107 | 0.030 | 0.300 | 0.250 | 0.023 |
| | 08 35 | 0030 | 21.3 | 6.8 | | 265 | 8.55 | 105 | 0.020 | 0.300 | 0.250 | 0.021 |
| | 08 35 | 0051 | 20.7 | 7.2 | | 263 | 8.50 | 98 | 0.030 | 0.300 | 0.260 | 0.022 |
| 75/09/15 | 14 25 | 0000 | 21.4 | 5.4 | 84 | 420 | 8.20 | 164 | 0.020K | 0.200 | 0.680 | 0.063 |
| | 14 25 | 0005 | | 5.5 | | 416 | 8.20 | 162 | 0.020K | 0.200 | 0.680 | 0.064 |
| | 14 25 | 0015 | 21.2 | 5.4 | | 416 | 8.20 | 163 | 0.020K | 0.200 | 0.680 | 0.063 |
| | 14 25 | 0030 | 21.1 | 5.0 | | 413 | 8.20 | 164 | 0.020K | 0.200 | 0.690 | 0.064 |
| | 14 25 | 0053 | 21.0 | 5.0 | | 415 | 8.15 | 164 | 0.020K | 0.200K | 0.690 | 0.064 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00665 PHOS-TOT MG/L P | 32217 CHLRPHYL A UG/L | 00031 INCDT LT REMNING PERCENT |
|---|---|---|---|---|---|
| 75/04/08 | 10 25 | 0000 | 0.083 | 22.8 | |
| 75/08/04 | 08 35 | 0000 | 0.041 | 9.6 | |
| | 08 35 | 0005 | 0.047 | | |
| | 08 35 | 0015 | 0.044 | | |
| | 08 35 | 0030 | 0.044 | | |
| | 08 35 | 0051 | 0.042 | | |
| 75/09/15 | 14 25 | 0000 | 0.074 | 10.0 | |
| | 14 25 | 0005 | 0.071 | | |
| | 14 25 | 0015 | 0.076 | | |
| | 14 25 | 0030 | 0.080 | | |
| | 14 25 | 0053 | 0.080 | | |

K VALUE KNOWN TO BE
LESS THAN INDICATED

# APPENDIX E

# TRIBUTARY DATA

STORET RETRIEVAL DATE 76/08/12

4103A1
45 14 10.0 116 42 10.0 4
SNAKE RIVER
41 15 CUPRUM
O/HELLS CANYON RESERVOIR 130892
BELO HELLS CYN DAM 10.5 MI N OF CUPRUM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/10/20 | 12 30 | | 0.768 | 0.200 | 0.025 | 0.075 | 0.075 |
| 74/11/23 | 14 40 | | 0.920 | 0.300 | 0.035 | 0.055 | 0.060 |
| 74/12/14 | 16 00 | | 1.010 | 0.400 | 0.060 | 0.045 | 0.050 |
| 75/01/04 | 14 30 | | 1.040 | 0.200 | 0.065 | 0.045 | 0.050 |
| 75/01/25 | 13 22 | | 0.850 | 0.200 | 0.016 | 0.024 | 0.030 |
| 75/02/09 | 13 50 | | 0.768 | 0.800 | 0.032 | 0.016 | 0.050 |
| 75/02/22 | 15 00 | | 0.720 | 0.400 | 0.044 | 0.016 | 0.040 |
| 75/03/09 | 13 30 | | 0.790 | 0.600 | 0.028 | 0.024 | 0.060 |
| 75/04/13 | 13 15 | | 0.470 | 1.550 | 0.045 | 0.020 | 0.070 |
| 75/05/17 | 13 15 | | 0.060 | 0.600 | 0.025 | 0.015 | 0.100 |
| 75/06/07 | 14 40 | | 0.085 | 1.350 | 0.055 | 0.010 | 0.045 |
| 75/08/09 | | | 0.260 | 0.550 | 0.025 | 0.025 | 0.060 |

STORET RETRIEVAL DATE 76/08/12

4103A2
44 08 10.0 116 50 15.0 4
SNAKE RIVER
41 15 COPPERFIELD
T/HELLS CANYON RESERVOIR 130791
BELO OXBOW DAM 1 MI SE OF COPPERFIELD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/10/19 | 13 30 | | 0.800 | 0.500 | 0.040 | 0.065 | 0.075 |
| 74/12/14 | 14 00 | | 0.960 | 0.300 | 0.060 | 0.045 | 0.050 |
| 75/01/04 | 12 05 | | 0.980 | 1.400 | 0.080 | 0.045 | 0.050 |
| 75/04/13 | 11 35 | | 0.510 | 1.200 | 0.035 | 0.020 | 0.070 |

STORET RETRIEVAL DATE 76/08/12

410381
45 08 30.0 116 43 30.0 4
KINNEY CREEK
41 15 CUPRUM
T/HELLS CANYON RESERVOIR 130892
PRVT PVD RD BRDG 6 MI S OF HELLS CYN DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/10/20 | 11 50 | | 0.216 | 0.100K | | 0.020 | 0.020 |
| 74/11/23 | 14 10 | | 0.248 | 0.100K | 0.040 | 0.015 | 0.015 |
| 74/12/14 | 15 30 | | 0.280 | 0.100 | 0.015 | 0.020 | 0.030 |
| 75/01/04 | 13 30 | | 0.296 | 0.400 | 0.010 | 0.015 | 0.030 |
| 75/01/25 | 12 55 | | 0.336 | 0.550 | 0.024 | 0.010 | 0.021 |
| 75/02/09 | 13 23 | | 0.320 | 0.450 | 0.008 | 0.024 | 0.030 |
| 75/02/22 | 14 20 | | 0.376 | 0.200 | 0.012 | 0.024 | 0.024 |
| 75/03/09 | 13 00 | | 0.276 | 0.400 | 0.012 | 0.024 | 0.030 |
| 75/04/13 | 12 30 | | 0.270 | 0.662 | 0.040 | 0.020 | 0.020 |
| 75/05/17 | 13 45 | | 0.130 | 0.300 | 0.020 | 0.025 | 0.060 |
| 75/06/07 | 14 10 | | 0.105 | 0.750 | 0.025 | 0.015 | 0.100 |
| 75/08/09 | | | 0.210 | 0.400 | 0.030 | 0.110 | 0.140 |
| 75/09/28 | 11 25 | | 0.230 | 0.800 | 0.010 | 0.015 | 0.030 |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4103C1
44 09 15.0 116 49 50.0 4
INDIAN CREEK
41 15 COPPERFIELD
T/HELLS CANYON RESERVOIR 130791
PRVT PVD RD BRDG 1.5 MI N OF OXBOW DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/10/20 | 15 30 | | 0.048 | 0.400 | 0.010 | 0.010 | 0.010 |
| 74/11/23 | 13 00 | | 0.056 | 0.500 | 0.050 | 0.010 | 0.010 |
| 74/12/14 | 14 00 | | 0.112 | 0.400 | 0.010 | 0.010 | 0.010 |
| 75/01/04 | 12 55 | | 0.590 | 1.700 | 0.015 | 0.019 | 0.020 |
| 75/01/25 | | | 1.060 | 0.600 | 0.024 | 0.016 | 0.016 |
| 75/02/09 | 12 00 | | 0.272 | 0.100 | 0.040 | 0.016 | 0.020 |
| 75/02/22 | 13 30 | | 0.392 | 0.100 | 0.016 | 0.024 | 0.030 |
| 75/04/13 | 11 45 | | 1.100 | 1.450 | 0.025 | 0.035 | 0.100 |
| 75/06/07 | 13 30 | | 0.460 | 0.400 | 0.005 | 0.025 | 0.050 |

STORET RETRIEVAL DATE 76/08/12

410301
44 57 21.0 116 52 15.0 4
PINE CREEK
41 15 COPPERFIELD
T/HELLS CANYON RESERVOIR 130892
GAGING STATN 1.8 MI S OF COPPERFIELD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 74/11/23 | 11 | 30 | 0.048 | 1.100 | 0.050 | 0.010 | 0.020 |
| 74/12/14 | 12 | 00 | 0.104 | 0.300 | 0.010 | 0.015 | 0.020 |
| 75/01/03 | 10 | 00 | 0.192 | 0.700 | 0.030 | 0.022 | 0.040 |
| 75/01/25 | 10 | 00 | 0.320 | 0.200 | 0.016 | 0.016 | 0.020 |
| 75/02/09 | 10 | 00 | 0.552 | 0.500 | 0.056 | 0.024 | 0.050 |
| 75/02/22 | 11 | 00 | 0.704 | 0.700 | 0.016 | 0.024 | 0.035 |
| 75/03/09 | 10 | 50 | 0.870 | 1.000 | 0.008 | 0.048 | 0.180 |
| 75/04/13 | 09 | 35 | 0.520 | 2.400 | 0.085 | 0.020 | 0.060 |
| 75/05/17 | 14 | 15 | 0.125 | 0.300 | 0.035 | 0.020 | 0.140 |
| 75/06/07 | 11 | 00 | 0.115 | 0.500 | 0.015 | 0.015 | 0.120 |
| 75/08/09 | | | 0.025 | 0.650 | 0.020 | 0.020 | 0.050 |
| 75/09/28 | | | 0.015 | 0.600 | 0.010 | 0.005K | 0.030 |

K VALUE KNOWN TO BE
LESS THAN INDICATED